

Responses to TCEQ Information Request Received December 14, 2017

TCEQ Request Number One:

Please provide details of how Arkema prepares and mitigates flooding at the Crosby Site. Include specific information on the preparation for flooding due to Hurricane Harvey.

Response:

The Crosby plant facility has a well-defined Hurricane Preparedness Plan, which was implemented prior to Hurricane Harvey. The Crosby plant's Hurricane Preparedness Plan is designed to protect workers and property before, during, and after a storm. The Crosby plant began its hurricane preparations months in advance of Harvey, and started preparing specifically for Harvey well before the storm hit the Texas coast.

The Crosby plant's hurricane preparedness planning begins each May, at the beginning of hurricane season. Hurricane planning includes ensuring plant personnel are trained in accordance with the Hurricane Preparedness Plan; establishing staffing procedures for "ride out crews;" activating emergency equipment; and securing portable emergency generators. The plan also addresses flood risks by requiring plant personnel to fill storage tanks and dumpsters to keep them from floating; to obtain a flat bottom boat to move through floodwaters; to stock waders for use in walking through floodwaters; and to acquire an off-road forklift capable of moving through high water. All of these actions and others were implemented by the Crosby personnel prior to Harvey.

The plant's Storage Building Limits and Safety Guidelines also allows for the storage of low temperature products in refrigerated trailers in emergency situations. In 2016, Arkema developed an Emergency Response Plan (ERP) that addressed flooding, and the ERP's flood planning was validated by Arkema's property insurance carrier.

While Hurricane Harvey was still in the Gulf of Mexico, the Crosby plant tracked the storm's trajectory and severity; topped off backup generators; filled portable totes with diesel fuel; filled the diesel tank; arranged for supplemental diesel delivery; prepared the liquid nitrogen system for back-up refrigeration and ensured that the nitrogen tank was full; brought in food and communications equipment for the ride-out crew; ordered and received a heavy duty off-road forklift and a flat-bottomed boat; pumped down the wastewater tanks to accommodate rainfall in the process areas; secured loose materials and elevated portable equipment above potential floodwaters.

The plant's manufacturing chemical production operations were stopped and fully secured prior to the storm, and no incident from the chemical production operations portion of the facility occurred. By August 24, the Crosby plant began the process of a plant shut-down, completing full shut-down by August 25. Moreover, prior to the storm, Arkema told suppliers not to send raw materials, and informed customers that production would be stopped. In addition to the cessation of chemical production, full plant shut down included: emptying and washing process equipment, staging equipment such as pumps, hoses and sandbags, and reviewing storm scenarios and corrective actions with members of the Hurricane Preparedness Committee and with the ride-out crew.

During the storm itself, the ride out crew monitored conditions at the plant, focusing on utilities and the wastewater treatment system. Members of the crew also performed surveillance trips and took actions to secure on-site materials. Ultimately, the ride-out crew also engaged in scenario planning to deal with the fast-rising flood waters, such as the possibility of de-energizing certain equipment to prevent electrocution risk and equipment damage.

The site's ERP was followed. The ERP addresses decompositions, loss of power, and severe weather such as flooding. Specifically, for flood scenarios, it requires the plant to monitor levels in secondary containment; open storm water containment gates as needed; secure containers/equipment; and monitor levels in sanitary sumps.

It should be noted that the ride-out crew's real-time understanding of the situation was that it was manageable until the unthinkable happened: on top of the sizeable precipitation that had already fallen at the plant, on Saturday night and into Sunday morning, Harvey stalled. This resulted in the facility receiving a deluge of more than 23 inches of rainfall in less than 24 hours. Thus, despite all of the on-site preparatory and storm-related efforts, the Crosby plant was still greatly challenged by the unprecedented size and magnitude of this particular storm.

TCEQ Request Number Two:

Please discuss the possibility of moving the organic peroxides (Product) offsite via trailer or other transport during an emergency or natural disaster such as Hurricane Harvey. Discuss whether the option of moving the product was considered and key factors that led to the decision to store the products onsite during Hurricane Harvey.

Response:

Moving organic peroxides offsite prior to or during a hurricane event raises numerous safety and logistics-related concerns. Until Harvey was basically on top of Harris County on Friday August 26, the forecasts for the storm indicated that the worst of it would hit to the south and west of Crosby, and the predicted amounts of rainfall were grossly understated, both in amounts and duration, from what actually occurred. Harvey proved to be a storm of unprecedented magnitude, in terms of volume, breadth and intensity.

Arkema's Hurricane Preparedness Plan requires that the plant consider moving products to a safer location or to an off-site warehouse storage location. These types of movements could address business logistic concerns, such as ensuring continuity of supply to customers. Under certain conditions, safety considerations might also drive the decision to move product, such as moving products from an on-site structure potentially prone to damage in high winds or to power loss to a more secure storage facility on-site.

The Plan states that the implementation of each portion of the Plan depends upon the storm's forecast. Generally, however, multiple safety factors would caution against moving organic peroxide chemicals and particularly low-temperature organic peroxides offsite. There are also practical logistical concerns that pose challenges for movement of large amounts of inventory during a storm of the magnitude, breadth and changing trajectory of Harvey. Considering the safety and logistical factors during a storm such as Hurricane Harvey, moving the chemicals offsite was considered but rejected based upon the

storm's forecast. By the time the forecast changed, there was insufficient time to implement product movement as a realistic solution.

Harvey

While it is easy to say that "everyone knew" a storm of this magnitude was coming, the historical record does not bear that out. The forecast itself was constantly changing, as was the track of the storm. It is extremely difficult to predict weather 5 days in advance, particularly rainfall totals, and this fact poses challenges in industrial planning. This is borne out by the Hurricane Harvey forecasts for Harris County.

A review of the forecasts coming from the National Weather Service (NWS) and the National Hurricane Center (NHC), and the data that was being provided in real time to government, industry and the public, indicates that there were many fluctuations in their five and seven day forecasts for Harvey, and no one anticipated a storm of this magnitude to hit eastern Harris County until it was virtually on top of the region.

According to the NHC's Post-Harvey report, "Harvey was the most significant tropical cyclone rainfall event in United States history, both in scope and peak rainfall amounts, since reliable rainfall records began around the 1880s." However, the experts' tracking of the worst tropical cyclone rain event in the U.S.'s history demonstrates the difficulty in forecasting storms of this nature. "Harvey was nothing but a tropical storm days before it hit," said Harris County Judge Ed Emmett. "And then suddenly it became a hurricane. ... If we had someone to tell us what it is that caused Harvey to blow up into a hurricane instead of a tropical storm, that would help us." Even within Harris County, before the storm stalled above all of Harris County, the predicted amount of localized rainfall and flooding was highly variable. By the time accurate weather predictions were available at the Crosby plant, the storm was incapacitating, thus making the movement of significant quantities of product from the site unviable.

A. 25 Year Rainfall and Flood Records in Comparison to Harvey

Let's start with the basics. The NHC's Post-Harvey report states, "While the peak rainfall amounts were exceptional over Texas, the areal extent of heavy rainfall is truly overwhelming, literally and figuratively.... Large sections of southeastern Texas received 3 ft or more of rainfall in Harvey, whereas only very small portions of the Houston metro area had those totals in Allison. Beulah had one of the largest 10 inch or greater rain shields on record, similar to Harvey's. For any total above 15 inches, however, Harvey's area(s) are considerably larger. In fact, NOAA recently completed an analysis of annual exceedance probabilities for southeastern Texas after Harvey, with a large portion of that area experiencing a flood with less than a 1-in-1000 (0.1%) chance of occurring in any given year (e.g., a 1000-year or greater flood). ***While established records of this nature are not kept, given the exceptional exceedance probabilities, it is unlikely the United States has ever seen such a sizable area of excessive tropical cyclone rainfall totals as it did from Harvey.***" (emphasis added).

Using the closest rainfall and river gauges to the Crosby plant that are maintained by the Harris County Flood Control District (rain gauge 1840 and river gauge 1740), it is verifiable that August 2017 *was twice as rainy as any other month over the past 25 years*. The previous record during that time was 20.91 inches measured in October 1994. August of 2017 was *over twice* that previous record at 42.76 inches.

The total rainfall from Friday August 25 through Tuesday August 29 was 37.88 inches. That five-day period, in and of itself, was 16.97 inches higher than the highest monthly total over the past 25 years.

But it wasn't just the total amount of rainfall that caused issues. It was the intensity of the storm itself. Peak rainfall at Crosby occurred on Saturday and Sunday, when *over 28 inches of rain fell*. Again, that one 24-hour period exceeded the previous *monthly* record for August from the past 25 years *by over 6 inches*. And in comparison to any previous rainfall record for any month over the past 25 years (which record was 19.99 inches recorded between October 15-18, 1994), *Harvey was nearly double that amount at almost 38 inches*.

The October 15-18, 1994 time period also saw the previous 25-year high crest for Cedar Bayou at 56.08 feet. Harvey smashed that record with a measurement of 59 feet, nearly 3 feet higher across the watershed. Harvey was immense and unprecedented. And it was extremely difficult to forecast.

B. The Ever-Changing Forecast

The official weather services that provide data are the NWS and the NHC. NWS and NHC are the "gold standard" as they have large staffs of meteorologists, over 100 land-based bureaus (NWS), and high-tech equipment that includes satellite imagery and sophisticated computer modeling. But even with all of these tools and resources, forecasting a tropical cyclone of this nature is extremely difficult, and this is borne out by a review of the forecasts coming from these authorities.

1. Saturday, August 19

Starting 7 days out, on August 19th, the Saturday before Harvey wreaked such devastation across Crosby and Harris County, it was a former tropical storm that had weakened to a remnant low in the central Caribbean. As the NHC advised at 11 pm EDT Saturday August 19, "[t]his is the last public advisory issued by the National Hurricane Center on this system unless regeneration occurs or if tropical cyclone watches or warnings are required for land areas." Basically, a week before the worst of the storm pounded eastern Harris County, and only 6 days before it made landfall as a Category 4 hurricane, it was being downplayed by the NHC.

2. Sunday, August 20

On Sunday, August 20th, the NHC discussed the remnants of TS Harvey in its tropical outlooks, but no forecast track was issued. The NHC gave formation chance through 48 hours a "low" probability at 30%, and formation chance through 5 days was "medium" at 40 percent. NHC stated: "Disorganized showers and thunderstorms over the central Caribbean Sea are associated with the remnants of Harvey. Unfavorable upper-level winds and dry air are expected to inhibit development today. Environmental conditions could become a little more conducive for regeneration by Monday when the system moves west-northwestward over the northwest Caribbean Sea, and interests in northern Nicaragua, Honduras, Belize, and the Yucatan peninsula should monitor the progress of this system." Nothing was mentioned about Texas less than 5 days before it made landfall in that state as a major hurricane.

3. Monday, August 21

By 8 am Monday, August 21st, 5 days out from the worst 24-hour rainfall at Crosby in the last 25 years and 4 days out from landfall as a major hurricane, the NHC gave formation chance through 48 hours a

“medium” probability at 50 %, and formation chance through 5 days a “high” at 80%. But there was still no projected impact on Texas. The NHC stated “[s]ome development of this system is still possible before it reaches the coast of Belize or the Yucatan Peninsula early Tuesday. The disturbance is forecast to move into the Bay of Campeche early Wednesday, where environmental conditions are expected to be more conducive for redevelopment. Regardless of development, locally heavy rainfall and gusty winds are likely to spread westward across northern Nicaragua, Honduras, Belize, and the Yucatan Peninsula during the next couple of days.”

4. Tuesday, August 22

At 1 pm on Tuesday, August 22nd, 4 days out from the Crosby devastation and 3 days out from landfall, the NHC mentioned Texas and told people with interests in Texas to “monitor” the storm. Formation chances through 48 hours was again moved upward to “high” at 90 percent, and formation chances through 5 days was “high” and “near 100 percent.” The narrative stated: “Environmental conditions are conducive for development when the system moves over the Bay of Campeche tonight, and a tropical depression is expected to form over the southwestern Gulf of Mexico on Wednesday or Thursday, and move in the general direction of the Texas coast on Friday. Interests in northeastern Mexico and along the Texas coast should monitor the progress of this system, as it could produce storm surge and tropical storm or hurricane force winds along portions of the Texas coast, and very heavy rainfall across portions of central and eastern Texas from Friday through the weekend.”

Prior to Tuesday, computer models had been projecting Harvey to redevelop in the southwest Gulf and track west-northwestward into Mexico, staying well south of the upper Texas coast. However, Tuesday morning’s model runs shifted significantly northward, taking Harvey inland into the lower Texas coast in the vicinity of Corpus Christi on Friday night. As Harvey was predicted to move inland near Corpus Christi and then stall, there was a concern that a nocturnal heavy rainfall event would develop near the storm’s decaying low pressure area, most likely west and northwest of Matagorda Bay, approximately 140 miles to the southwest of the Crosby area.

5. Wednesday, August 23

The storm continued to change and develop, as did the forecast. On Wednesday August 23, the NHC issued a tropical storm watch for the upper Texas coast at 10:04 am, and it was predicted to stall inland and then drift eastward. Model guidance on Wednesday morning was split on Harvey’s track. Nearly half of the models took Harvey southwestward into Mexico after landfall, with the rest taking Harvey northeastward. This indicates that track uncertainty was higher than average.

The NHC and the Houston/Galveston NWS office predicted 10 – 15 inches of rain near the coast, with an isolated 20 inches over the subsequent 7 days. The forecast was tempered because of difficulties in projecting the actual track of the storm, and it was clear from the forecast that the location of the heaviest rainfall could still change, but the warning itself states that the heaviest rain was expected in coastal counties, with lesser amounts inland. The track of the storm was still well to the south and west of the Crosby plant. Forecasts indicated that Harvey would track inland near Corpus Christi (which is over 200 miles away from Crosby) and then stall and dissipate, staying well to the southwest of the upper Texas coast. Based on prior experience at the plant, the 10- 15 inches predicted over 7 days would not have presented an issue as the plant had routinely managed similar rainfall amounts in the past. And while rainfall amounts of 10 to 15 inches would likely lead to some occasional travel delays across southeast Texas, there were no indications of widespread flooding affecting the Crosby area.

6. Thursday, August 24

The forecast was revised higher at 6 am on Thursday, August 24. At 6 am, the Houston/Galveston NWS office predicted 10-15 inches of rain with isolated totals to 20+ inches, but there remained considerable forecast uncertainty beyond landfall. At 4 pm, the NWS office modified the forecast, now calling for 15 – 25 inches of rain **over the next seven (7) days**, with isolated totals of 30+ inches between Galveston and Matagorda Bay **over that 7-day period**. The worst of the storm was predicted for the areas south of I-10 (the Crosby plant is located north of I-10). Model forecasts that morning were still in poor agreement, leading to considerable uncertainty as to the precise location of the core of Harvey's heaviest rainfall. Again, the details of the track were uncertain.

It was not until 4 pm on Thursday, two days before the rainfall catastrophe, that a flash flood watch (not a warning) was extended to Harris County for the first time. By late afternoon, both the NWS and NHC were indicating that rainfall could reach as high as 15-25 inches with some areas receiving 35 inches through 7 pm CDT the next Thursday. The heaviest rain was predicted to be centered on the middle Texas coast near the Victoria area (Victoria is approximately 150 miles from Crosby). Although "catastrophic flooding" potential was mentioned, it was thought that the flooding would be centered in Matagorda and Jackson County. In a special Harvey statement issued by the Houston-Galveston NWS office at 4:38pm, they indicate that the greatest risk of flooding will be "for areas along and south of a Columbus to Houston line". This would not include the Crosby area.

7. Friday, August 25

On Friday morning, August 25, the forecast was still calling for the worst of the storm to hit areas south of the I-10 corridor. The 7-day totals were now at 15 – 25 inches across Harris County, with isolated totals moved up to 35 inches. The Houston/Galveston NWS office indicated that the greatest rainfall threat is centered near Victoria, TX, about 150 miles to the southwest of the Crosby area. That's where the bullseye of 15-25 inches with isolated 35 inches was expected over the next 7 days. The 5 a.m. statement says "potentially devastating flooding south of I-10 across southeast Texas." There was still considerable variability in the model guidance Friday morning. Though most of the models did indicate the slow movement and looping of the storm after landfall, there was still a good bit of spread in the models regarding Harvey's track post-landfall.

There were no significant changes in the forecast until 4 pm when the numbers again were modified upward to 15-30 inches and isolated totals of 40 inches over 5 days. Though the maximum potential rainfall was increased to 40 inches, the track forecast had Harvey moving even more slowly toward Houston, not reaching Harris County until Wednesday afternoon. The heavy rainfall bulls-eye was centered over Wharton County, about 90 miles southwest of the Crosby area. Based on the projected track of Harvey toward Harris County by Wednesday afternoon, it was possible that the heaviest rain wouldn't fall until Wednesday. Again, there was no mention of the timing of heaviest rainfall across Harris County in either the NWS or the NHC forecasts.

8. Saturday, August 26 – Monday, August 28

The forecast remained virtually the same very early Saturday morning, August 26, with 15-30 inches and isolated totals of 40 inches over 5 days. For Harris County, the two-day forecast called for 4-6 inches through Saturday night, another 4-6 inches for Sunday through Sunday night, and then 3-4 more inches

through Monday night. The range was thus 11 – 16 inches from Saturday night through Monday night. At 4 pm, the two-day forecast changed dramatically, with 8-12 inches of rain through Saturday night and 6-10 additional inches for Sunday through Sunday night. The NWS also issued an update for “major” or “record” flooding, with “record” being defined as “impacts unknown and beyond anything experienced.”

Saturday night into Sunday morning was catastrophic in eastern Harris County. At 3:08 am, Houston/Galveston NWS issued a flash flood warning for the area including Crosby until 6:30 am. Heavy squalls were dropping 3 – 5 inches of rain *per hour*. At 5 am, Doppler radar estimated 15-25 inches of rain had fallen across southeastern Harris County overnight, and models were predicting heavy rain to continue until early-to-mid afternoon. Houston/Galveston NWS stated that another 15-25 inches of rain was expected through Wednesday, August 30th. Crosby was now predicted to get another 4-6 inches of rain through 7 pm, and then 2-4 more inches by 7 am on Monday.

The forecast continued to evolve and get steadily worse. At 10 am Sunday, NHC stated that total rainfall from Harvey may reach 50 inches by Thursday. By this point, unprecedented flooding was occurring all across southeast Texas. Major to record flooding of bayous and rivers was ongoing and expected to continue. Moderate rain was predicted to continue, with Houston/Galveston NWS office predicting another 8-12 inches of rain between 4 pm Sunday and 7 pm Tuesday. And there was the possibility of an additional 15-20 inches of rain between 4 pm Sunday and 7 pm Friday September 1.

By 10 pm Monday, widespread totals of 30-40 inches of rain had fallen across Harris County, and the predictions kept coming: NWS predicted another 6-8 inches by 7 pm Tuesday, and additional 10-15 inches through 7 pm Thursday August 31.

As is now known, Harvey dumped huge amounts of rain over an area so vast that it stunned meteorologists. Flooding and damage from Harvey was massive and widespread.

Safety Issues

Materials are safest when they are stored in permanent locations, with multiple layers of protection, and attended to and handled by skilled workers trained in those chemicals.

A. Maintaining and Securing On Site is the Industry Standard

Generally, it is much safer to maintain hazardous chemicals on site than to attempt to relocate them. This is true for most chemicals, including organic peroxide materials. Keeping chemicals on site in dedicated systems, rather than trying to move them into the community where there are no safeguards or trained employees to monitor and maintain them, is the generally accepted industrial safety practice.

Organic peroxide facilities are purposefully constructed in isolated areas. The chemistry is essential to many chemical processes, but the products are also potentially unstable. Keeping the products away from densely populated urban core centers as much as possible is an established and prudent industry safeguard.

B. Plant Siting and Construction Accounts for Safety

Not only were Arkema’s organic peroxide plants built miles away from dense urban population centers, but they were also constructed in such a way as to account for the unstable nature of the chemistry. For

instance, the Crosby plant features seven separate product storage facilities equipped for low-temperature products. This is purposeful: isolating quantities allows for more manageable movement of the materials, provides a safety factor should some of the products become unstable, takes into account protective fire codes, and accounts for the possibility of a power loss or other building failure by keeping some extra storage capacity in other buildings to maintain the products on site.

C. Shipping to Customers is Not Preferable

Keeping the products in a plant specifically designed for their manufacture and storage is state-of-the-art within the organic peroxides industry. The reason that products are temporarily stored on-site and not shipped in bulk immediately to customers is because customers use comparably small quantities and lack the specialized capability of storing large amounts of potentially unstable products, particularly those requiring refrigeration. Given the physical location of the customers that use organic peroxides, some of whom are located in and around densely populated areas, this makes a great deal of safety sense.

D. Offsite Locations Are Not Readily Available

Another practical concern is where to take the materials. Having to secure an offsite warehouse capable of managing these types of products is not simple – they need to have specialized refrigeration; be physically isolated; be properly permitted, inspected and insured; and have trained personnel knowledgeable in handling the products. There are no “public” storage facilities (3rd party warehouses) that would simply take this product at a moment’s notice, or that have the properly trained workers readily available. It would be remarkable to have such a facility sitting idle at a remote location that is capable of managing large amounts of products in such a short period of time. In addition to these considerations, the regulatory environment for the products’ new location would have to be evaluated for possible permitting, reporting, or other lead time considerations that could delay product movement.

Arkema has one other U.S. facility that makes and stores low-temperature organic peroxides. That facility is located in Geneseo, New York, a distance of approximately 1,525 miles from Crosby, Texas. While that is a potential option for Arkema to use under the correct circumstance, it raises its own safety concerns discussed below and above.

E. Local Emergency Responders and Governmental Agencies

It is important to consider that Arkema has trained with the local Crosby Volunteer Fire Department, and provided that entity and other governmental agencies with significant information about chemicals stored on-site and used at the plant. Tier II reports, RMP plans, emergency response information, and other regulatorily-required information is localized. Moving organic peroxide products to an area that has emergency officials lacking knowledge of the products would be rightly criticized.

F. Other Chemicals at Multiple Facilities

While organic peroxides are the chemicals associated with this incident, there are hundreds of heavy industrial manufacturing locations in Harris County handling many thousands of hazardous chemicals at their sites. Any mandate requiring movement of just organic peroxides in the face of a storm threat must also consider how such mandate would apply to the relocation of these many other chemicals –

arguably far more dangerous. Stated otherwise, if there is a hard and fast mandate to ship the organic peroxides off-site, there is no reason not to extrapolate this approach to putting into rail cars and tankers these many other chemicals and relocating them across the country.

Such a mandate would create other issues, too. Moving a large quantity of hazardous materials is not a normal plant procedure. It requires loading/unloading and transportation activities that are out of the ordinary from typical operations. It would be unnecessarily hazardous in its own right. And moving these materials would put many thousands of other people at risk during transportation and loading/unloading. Moreover, it could potentially amplify a natural disaster into a much larger and impactful man-made crisis. And it would modify the state-of-the-art of chemical management during natural disasters, which is to manage chemicals on-site with trained personnel.

G. The False Alarm and Evacuation Experience of Rita

A question not explicitly asked by TCEQ, but one considered by Arkema, is what factual scenario would trigger the movement of chemicals. Unfortunately, Arkema is currently unaware of any accepted uniform standards available to industry today that would provide guidance on if or when to move materials. Clearly, there is a strong desire not to unnecessarily package, ship and put on the road hazardous materials due to false alarms, human error, forecasting issues, and non-significant weather events. These movements are not without risk. The Houston area has had well-documented issues with hurricane evacuations. For example, in 2005, Hurricane Rita resulted in an evacuation of about 3 million people, which contributed to at least 73 deaths. Houston officials generally order evacuations from storm surge waters, not rainfall flooding which is what the Crosby plant experienced with Hurricane Harvey. Tellingly, Houston officials did not order an evacuation of residents during Harvey even though they had up-to-date weather forecasts. It is hard to imagine an evacuation of the fourth largest city in the country accompanied by multiple trailers and railcars full of hazardous chemicals.

Arkema had a direct organic peroxides “near miss” experience during the Rita evacuation. The Crosby plant had shipped a tractor-trailer with cold organic peroxides to meet a customer demand. The tractor-trailer became stuck in Hurricane evacuation traffic outside of Houston and stood still for many, many hours. The tractor-trailer was running out of fuel, and the driver was concerned the cooling system would shut down. Traffic was at a standstill and the driver could not get to an exit. Arkema’s logistics team was monitoring the system closely with the driver. Fortunately, the driver was ultimately able to exit, refuel, and safely maintain the chemicals. But this experience colored Arkema’s perception of the safety of moving organic peroxides during storm and evacuation situations, and reinforced the deeply held belief that the safest place for dangerous materials is at the plant site itself.

Finally, it is remarkably unclear what can happen during an evacuation. Roadways and underpasses become flooded, resulting in modified transit routes. The final forecasts that called for severe flooding in Harris County were accurate in that major thoroughfares routinely used for the transport of chemicals, such as Interstate 10, were completely shut down due to flooding. And the amazingly widespread nature of Harvey impacted a huge swath of Southeastern Texas in a manner not seen before.

H. Forecasting Errors

Storms of this nature are extremely difficult to predict. In Florida, for example, it was predicted that Hurricane Irma would make direct landfall on the Miami area. While the prediction was based upon the

best models available to the highly skilled forecasters at the National Hurricane Center, it proved faulty. Landfall actually happened in Naples, 125 miles west of Miami. Had Arkema had an organic peroxides plant in Miami and moved them to the west coast of Florida in anticipation of the storm, that could have been a disaster. Movement is much riskier than stabilization on-site in dedicated facilities with emergency back-up plans in mind.

I. History

It should be noted that the Crosby site was not unprepared for power loss. While the Crosby site ultimately fell victim to the largest tropical storm ever recorded in the continental United States, it did have multiple redundant systems in place to maintain the safety of the products, and it had no experience similar to this one in its 50+ year operational history.

Arkema has been operating at the Crosby facility since the 1960s. During that time, many hurricanes, tropical storms, and unnamed storms featuring impressive rainfall totals have been experienced at the site. But Hurricane Harvey was different in many ways. It was unprecedented. And it had an impact on the Crosby site that had never occurred in the 50+ years of site operations. There had never been a storm of such magnitude that the site had to be evacuated, and where water prevented the free movement of equipment and personnel around the plant.

Logistics

If any company decided that it was a good idea to move hazardous chemicals in light of a potential storm or other natural phenomena, from a safety perspective, it would have taken significant advance planning. From a logistics perspective, it was not a decision that could have been made and implemented between August 23, 2017 and August 25, 2017 (when Harvey made landfall).

Beyond the fundamental and difficult questions of when to move products and where to relocate them, there are several limiting factors on the movement of the organic peroxide products: (1) the number of working tractor-trailers on site or otherwise available, as compared with the number of tractor-trailers needed to transport all the material on site; and (2) the number of available drivers. Arkema did not have enough tractor-trailers or drivers on site and under contract to move the product off-site on August 23-25.

A. Drivers

Currently, there are only (b) (3) (A) based in the Houston area that are used by Arkema to ship organic peroxide products. These drivers are not only HAZMAT drivers, but also receive special Arkema training for movement of organic peroxides.

B. Available Trailers

As of August 23, Arkema had 3 tractor trailers that were road worthy on site. The other 3 trailers were for temporary, emergency storage, and used for on-site purposes only. While the on-site trailers were loaded with all of the low temperature products, those products could not have been shipped off-site with those loads. Assuming near-perfect utilization of trailer space in terms of weight and loading,

Arkema would have needed (b) (3) tractor-trailers, and (b) (3) drivers to transport all of the cold storage products, and an additional (b) (3) tractor-trailers and drivers to transport all of the ambient materials warehoused at Crosby on August 23, 2017. Assuming they were going to be moved to Geneseo, New York, a distance of over 1500 miles, it would have been impossible to do this prior to the storm.

C. Lead time to get the drivers and trailers to the site, and time to load and get the products out.

Even assuming *arguendo* that sufficient drivers and trailers could be located, it would have taken time to get those assets to Crosby. It takes 60-75 minutes to load each trailer. Then the trailers run another 60 min. to ensure they are cooled, and the cooling system is functioning properly, before they leave the plant. This process would take many hours, and require significant lead time. Following that process, the materials need to be transported, unloaded, and then returned for additional loads.